AD-A266 403

PL-TR-92-2342

Optical Ionospheric Instrumentation and Research

Robert H. Eather
Peter A. Ning

Keo Consultants
27 Irving St.
Brookline MA 02146

18 December 1992

Final Report
3 November 1989 - 3 November 1992

PHILLIPS LABORATORY
Directorate of Geophysics
AIR FORCE MATERIEL COMMAND
HANSCOM AIR FORCE BASE, MA 01731-5000

"This technical report has been reviewed and is approved for publication"

HOWARD KUENZLER
Contract Manager

JOHN E. RASMUSSEN
Branch Chief

WILLIAM K. VICKERY
Division Director

REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

Public reporting burden for this collection of information is estimated ... gathering and maintaining the data needed, and completing and reviewing ... collection of information, including suggestions for reducing this burden ... Davis Highway, Suite 1204, Arlington, VA 22202-4302 ...

1. AGENCY USE ONLY (Leave blank)	2. REPORT DATE 18 DEC 1992	3. REPORT TYPE AND DATES COVERED Final 03NOV89 - 03NOV92

4. TITLE AND SUBTITLE Optical Ionospheric Instrumentation and Research	5. FUNDING NUMBERS PE 62101F PR 4643 TA 08 WUAS Contract: F19628-89-C-0187
6. AUTHOR(S) Robert H. Eather Peter A. Ning	
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) Keo Consultants 27 Irving St. Brookline MA 02146	8. PERFORMING ORGANIZATION REPORT NUMBER
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES) Phillips Laboratory Hanscom AFB MA 01731-5000 Contract Manager: Mr. H. Kuenzler/GPIA	10. SPONSORING/MONITORING AGENCY REPORT NUMBER PL-TR-92-2342
11. SUPPLEMENTARY NOTES	
12a. DISTRIBUTION/AVAILABILITY STATEMENT Approved for public release; distribution unlimited.	12b. DISTRIBUTION CODE

13. ABSTRACT (Maximum 200 words)

Keo Consultants participated in the research of the Ionospheric Applications Branch at Phillips Laboratory, by implementing improvements in research optical instrumentation (photometers and imagers). This research involved numerous field trips to study aurora, airglow, ionospheric scintillations, barium releases, and heater experiments. Keo customized instrument control software for each application, and developed software to display the resultant images and compare with other data sets.

14. SUBJECT TERMS Ionosphere; Aurora; Airglow; Optical Instrumentation	15. NUMBER OF PAGES 52
	16. PRICE CODE

17. SECURITY CLASSIFICATION OF REPORT	18. SECURITY CLASSIFICATION OF THIS PAGE	19. SECURITY CLASSIFICATION OF ABSTRACT	20. LIMITATION OF ABSTRACT
Unclassified	Unclassified	Unclassified	SAR

NSN 7540-01-280-5500

Standard Form 298 (Rev. 2-89)
Prescribed by ANSI Std. Z39-18

This page intentionally blank

Table of Contents

1. Contract Objectives:

To participate in the research of the Ionospheric Applications Branch at the Phillips Laboratory (PL), by implementing improvements in current instrumentation, software, data recording and analysis systems. This instrumentation is used in the study of various auroral and airglow phenomena and scintillation studies. Keo participated in field trips by assisting in the operation of the optical equipment, and worked to optimize the software operating systems for each specific experiment. Keo also participated in subsequent data analysis as required by PL scientists.

This was a three year contract, beginning on Nov. 3, 1989.

2. Hardware Support:

Keo assumed responsibility for the maintenance and repair of a number of research and analysis instrumentation systems, both for field and lab use. These include the ASIP-I, ASIP-II and ASIP-III imaging systems, the 6-Channel Photometer System, the IIPS Data Analysis System, and the Scintillation Voice-Mail System.

The following lists the main areas of hardware development, upgrading and maintenance during this Contract:

<u>1st Quarter:</u>

1. Keo assisted in the development, fabrication and packaging of hardware for eight scintillation measurement systems.

2. ASIP-II was completely checked over prior to field trips to Alaska and Norway.

<u>2nd Quarter:</u>

1. A study of available erasable optical disc units was undertaken to determine the most suitable for our applications. Peripheral Land, Inc. was selected as the supplier.

<u>3rd Quarter:</u>

1. A vignetting problem (encountered when the old ASIP-I all-sky lens was replaced by the higher-resolution Mamiya lens) was fixed by remounting the Westinghouse camera to adjust the length of the optics path.

2. A full electronic alignment of the ASIP-I Westinghouse camera was performed to investigate problems with image distortion, blooming, etc. Failed components were replaced, and the performance greatly improved. However it was recommended that this 14yr old SEC tube be replaced or upgraded.

3. Full checkout and overhaul of the 6-Channel Photometer system prior to installation in Greenland, including elimination of noise coupling. Cable lengths were extended for field operation.

4. A new image processing board had to be procured to replace the failing one originally delivered with the IIPS.

<u>4th Quarter:</u>

1. Calibration of the 6-Channel Photometer.

2. All chassis components were mounted in a rack-mount shipping box.

3. The filter wheel of ASIP-II was completely overhauled to correct occasional alignment problems. The unit was repainted.

4. A hard disk problem with the ASIP-II system was solved by obtaining a (used) replacement of this discontinued model.

5. An erasable optical disc drive was procured and integrated into the ASIP-II system, replacing the cumbersome (and troublesome) Kennedy tape recorder.

6. All documentation sets for field instruments were reviewed, updated, and reorganized. Three sets were completed: 1 for Keo, 1 for PL Lab., and 1 for field use.

<u>5th Quarter:</u>

1. The 6-Channel Photometer was physically installed at the Greenland site (involving construction of a wood frame for suspending from the ceiling under a dome). The new radar-slave mode of operation was tested and initial problems corrected.

2. A PC-based MO disk drive adapter card was installed as part of a data archival project for the branch.

<u>6th Quarter:</u>

1. A new 5-Position Filter Wheel was integrated into the ASIP-II system.

2. The new optical disc for ASIP-II was field tested in Greenland and worked well. Other general maintenance work was performed (cleaning air flow filters, removing dust, reseating boards and socketed ICs), especially with the computer boards .

3. Slave-radar tracking problems with the Photometer were investigated and largely corrected (intermittent cable, mechanical friction).

4. Assistance was provided in the assembly of racks and cabling for the Two Channel Amplitude and Phase Scintillation System chassis.

7th Quarter:

1. Video problems with the ASIP-I system were corrected prior to a CRRES campaign. The problem was an intermittently failing sync stripper unit which was replaced. A new HQ VCR unit was installed for recording backup.

2. Development of an automated voice-mail system for the Scintillation System was begun. This will allow users to phone in to field instruments and inquire about data. Voice is desirable as many remote sites have noisy phone links which are unsuitable for digital communications.

8th Quarter:

1. Mechanical modifications for the installation of the 5-Position Filter Wheel were completed.

2. An intermittent problem with one of the scan converter boards in the ASIP-II system was identified and corrected. A power distribution problem was also traced (broken lead wire) and corrected.

3. Filter size incompatibilities between ASIP-I and ASIP-II filter wheels were addressed. As the 4-Position Filter Wheel was to be removed from service, its larger filters were cut down to fit in the newer 5-position wheels.

4. A keogram camera was provided for field use as part of a cooperative program between AFPL and the University of Oslo. The camera was checked out both mechanically and photographically before shipment, and a detailed Operations Manual was written.

9th Quarter:

1. There were problems with computer crashes on the 6-Channel Photometer System during a Greenland campaign. Low humidity appears to be part of the problem; additional grounding wires were installed between the racks and the building frame.

2. The IIPS analysis system was changed by replacing two 40 Meg hard disks by one 80 Meg unit, allowing the 40 Meg units to be used on the Scintillation System. The cartridge tape was removed from the system.

3. The new ASIP-III was field tested for the first time, and operated satisfactorily except for some mechanical shutter problems. After exhaustive testing, we decided the shutters were not reliable enough mechanically, and should be replaced with another type.

10th Quarter:

1. The mechanical shutters on ASIP-III were replaced, including new housing assemblies.

2. Intermittent computer failures with ASIP-II were again traced to ribbon cable contact problems, particularly a shorted wire at a ribbon cable termination.

3. A "stuck" bit in the 6-Channel Photometer data was traced to the parallel interface card of the PDP-11 Q-bus. Cable problems resulted in shorting to the card, which was not protected by a solder mask layer. Insulating tape solved the problem.

4. The Kennedy tape recorder (used for backup) failed. As these are old units, it was recommended that they not be repaired or replaced, as future upgrades will involve optical disk recording.

5. Intermittent variations in image gain on ASIP II were found to be a camera head problem, so the Photometrics camera was returned to the manufacturer (under warranty) for repairs.

6. A tripod adapter was constructed, and a heavy-duty tripod supplied, so that the ASIP-III will have manual pan and tilt capabilities for a planned CRRES campaign.

11th Quarter:

1. A time base corrector and Sony video recorder were temporarily integrated into the ASIP-I system to ensure reliability on its last mission (after 16 years!).

2. ASIP-III was used in a CRRES campaign in Puerto Rico. Problems encountered were caused by poor AC power at the site, where voltages often were as low as 105VAC. Some of the problem was overcome by borrowing an UPS (uninterruptable P/S), but there were still shutter problems related to the low voltage. Software changes to ensure the shutters did not open simultaneously were implemented to circumvent the problem.

3. A sudden downpour soaked the instrument, which required disassembly and drying/cleaning. The CCD cooling circuit failed just prior to a barium release, but fortunately data was still obtained. The failure was due to high humidity and an underrated power connector, (which has been replaced).

4. Logistical support was provided for a demonstration of the Scintillation Voice-Mail system.

12th Quarter:

1. More computer memory was acquired for ASIP-III in order to accommodate the new software development environment.

2. A 340 Megabyte (AFPL owned) hard disk was integrated into ASIP-III to provide more storage memory for image files.

3. Components of ASIP-III's frame grabber board were upgraded in order to drive standard RGB monitors while preserving true 1:1 aspect ratio pixel outputs.

3. Software Development:

Keo provided continuing software support for field data acquisition, for data filing and storage, and for data analysis. This software is developed as needs arise. In addition, continuing efforts were made to upgrade current software for more efficient and convenient operation. A summary of support provided throughout this Contract follows:

<u>1st Quarter:</u>

1. No software development was made during this quarter since the full-time software engineer position has not been filled.

<u>2nd Quarter:</u>

1. A window/menu based utility software was written for the Northwest System (IIPS) to expedite the image transformation processing of backlog data. This generates command scripts to batch process the data.
2. A set of software tools were written for the IIPS in the area of handling parametric inputs. They include "CREATE","HARDCOPY", and "WILDTHG" (for generating multiple sets of parameter files).
3. A data correction program was written to handle errors in AIO's INS (Inertial Navigation System) and OTH data tapes.

<u>3rd Quarter:</u>

1. Keo subcontracted out the development of a software driver to be used on an MO (Magneto-Optical) Disk for ASIP-II.
2. Software tools were added to the IIPS to facilitate the analysis and presentation of coordinated measurements of both optical and radar data. This included upgrading the parametric text display quality, as seen in Figures 1 & 2.
3. A major effort was made to recalibrate and verify all the parameters used by the IIPS to generate accurate image transformations. The results are summarized in a text file called: "D:\NING\NOTES\ASIPCAL.TXT" (see Appendix A). The value used for the earth's radius was upgraded, as shown in Table 1.

<u>4th Quarter:</u>

1. OMNI command files were written to generate image contours (color bands on grayscale) on the IIPS in support of the analysis of heater experiments. A summary of these commands is given in Appendix B.
2. The MO Disk software driver on ASIP-II has been completed and will now store digitized images in a format identical to the one used on the 9-track tapes.
3. Software was written for the Six Channel Photometer's (AOS's) PDP-11 subsystem in order to implement radar tracking mode. This allows the AOS's

steerable optical head to slave to SRI's Incoherent Scatter Radar at Sondrestrom. The radar interface consists of two 8-bit digital ports (for azimuth and elevation). Binary to decimal degree mapping is shown in Table 2.

<u>5th Quarter:</u>

1. The MO Disk software driver have been upgraded to handle image files under an MS-DOS file format which will allow us to access and manipulate ASIP-II images on IBM-PC AT or AT-clone platforms without an extra level of analog/digital conversion. A list of the MS-DOS words in IoForth is given in Appendix C.

2. The radar plotting utilities has been extended to accommodate both vector and scalar plots. In addition to velocities, electron densities and ion temperatures can now be plotted. Examples of radar velocity vectors are shown in Figures 3 & 4.

3. An OMNI command file, "D:\NW\UTILS\CMD\LATLONG.CMD", has been created to display latitude and longitude labels on transformed images for the Sondrestrom site. Figure 5 shows a default grid overlay, while Figure 6 is the result of executing the command to generate grid labels.

<u>6th Quarter:</u>

1. To facilitate the analysis of AOS's data on a MacIntosh PC platform, two programs were written; one on the PDP-11 to transfer data serially to an IBM PC, and one on the IBM PC called "TXTTOMAC.EXE" to translate the data to MAC file format.

2. A utility program, called "DDATA:UTILS<TAPETOMO>" was written to transfer and convert ASIP-II images on tape to MO disks.

3. A conversion program called "D:\NW_UTILS\CVTIMAGE.EXE" was written to convert ASIP-II images into ITEX-100 image file format used by the IIPS's frame grabber board.

<u>7th Quarter:</u>

1. A program called "D:\NW_UTILS\FLATIMG.EXE" was written to apply an "inverse-vignetting" function to raw IIPS image files prior to the transformation phase. A linear "brightening" effect is seen when the program is applied to an image with uniform pixel values, see Figures 7 & 8. The effect on real data is shown in Figures 9 & 10.

<u>8th Quarter:</u>

1. A program called "D:\NW_UTILS\TGPLUS.EXE" was written for the IIPS to display image intensity profiles along an arbitrary line given by two azimuth-elevation coordinates.

2. A demo application called "D:\SACDEMO\SACDEMO.EXE" was written for the Remote Access SDRS project. It utilized the software driver support that came along with the project's voicemail board.

3. ASIP-II operational software was modified to accommodate the newly installed 5-position filter wheel. All software changes for this upgrade is documented in a file called "CAMERA:REVLIST", see Appendix D. Bootable floppy disks were created as backup for ASIP-II should the hard disk fail.

9th Quarter:

1. The boot sector on the PDP-11 hard disk had to be rebuilt. The software had to be loaded from backup floppies.

2. ASIP-II operational software was extended to include real-time image subtraction. This was coded at the 68000 assembly language level and can be found in file "CAMERA<UTILS>", which includes other useful utilities, see Appendix E.

3. Tools were written at the IBM-PC level to extract ASIP-II image parameters from their file header blocks.

4. Coding display driver routines was done as part of implementing ASIP-III's operational software.

10th Quarter:

1. ASIP-II's "CAMERA:UTILS<OPTDSK-LOOP>" routine was modified to handle automated transfer of images from the Sony Digital MO Disk to the Panasonic Analog Optical Disk.

2. IIPS's "CVTIMAGE.EXE" program has been updated to include a 5/4 pixel aspect ratio normalization and a date/time stamp correction.

3. A graphical display and menu selected qualitative descriptors were added to the voicemail diagnostics system.

11th Quarter:

1. ASIP-III's operating system has been upgraded to DOS 5.0 and Windows 3.1.

2. The software development environment has also been upgraded to MSC/C++ Version 7.0. This includes the Windows SDK (Software Development Kit).

12th Quarter:

1. An alarm/call back feature was added to the VoiceMail SDRS project to provide warning notifications to potential users.

2. An optical character recognition (OCR) package was installed on a PC-based system. This upgrade software was necessary for operating a page scanner under the system's Windows 3.1 environment.

3. A program called "MIPTONW.EXE" was written to convert ASIP-III's 12-bit image file format to IIPS's 8-bit image file format which includes pixel aspect ratio correction. Figure 11 shows the MIP display of four time-lapse images of a barium release. Figure 12 shows the result of applying the conversion to IIPS's display format.

4. Data Analysis:

Keo provides support for archiving, retrieving, and analysis of data from GL field campaigns. Data media include 35mm film, digital tapes, video tapes and optical discs. Data analysis includes various co-ordinate transformations, overlaying, and image enhancement operations. In general these data analysis services are at the request of GL scientists, who are responsible for the ultimate scientific interpretation of the data. the following summarizes services provided during this Contract.

<u>1st Quarter:</u>

1. All of the Rodeo I data were transferred from magnetic tape to an analog optical disk. Parameter files for the Rodeo II campaign were created, and data were processed and stored on a Sytos tape cartridge.

<u>2nd Quarter:</u>

1. More of the Rodeo I data were processed and stored on a backup tape cartridge. The Rodeo II campaign was then transferred from magnetic tape to the analog optical disk.

2. Parameter files for the CRRES 1990 campaign were created and some data were processed and stored, for use by Dr. Carlson and Dr. Weber. Due to the rapid growth of our library of processed data, a cataloging system was developed to allow for easier retrieval.

<u>3rd Quarter:</u>

1. More of the CRRES 1990 were processed. Composite flight-track images from AIO's ASIP-I can be found in Figure 13 & 14.

2. A request to process some POLAR ARCS February 1987 data also came from Dr. Carlson; a parameter file was created and the required data set was processed. Continued support was provided to facilitate analysis of this data set, as well as for the CRRES 1990 data.

3. Some Andoya 1988 data were also processed. All transformed data was backed up onto a Systos tape cartridge.

4th Quarter:

1. A parameter file was created for Steve Mende's Sondrestrom Oct. 1990 data and the data were processed, and relevant portions of the data recorded onto an analog optical disk.

2. Data from the February 1990 Sondrestrom campaign were transferred onto an analog optical disk.

5th Quarter:

1. The analysis of Steve Mende's Sondrestrom Oct. 1990 data was completed, and the data were stored on a Sytos cartridge.

2. The Polar Arcs data was recorded onto an analog optical disk.

3. Our library of processed data had grown so large that the Sytos backup cartridge system is no longer an efficient way to store data. The cartridges do not allow us to see what data is stored without consulting the log book, and retrieval of the data files is slow. Consequently a Magneto Optical Disk was installed in the Northwest System as a replacement for the Sytos system. The M.O. disk allows better file management, and the retrieval time is minimal.

6th Quarter:

1. The CRRES 1991 data from Andoya was processed for Dr. Weber and Dr. Carlson. Continued assistance was lent to Dr. Carlson concerning his requests for specific data sets from this campaign.

2. The Sondrestrom February 1991 campaign was recorded onto an analog optical disk.

3. Transferring of all data stored on the Sytos System to the new M.O. disk was started .

7th Quarter:

1. Analysis of the CRRES 1991 data was completed.

2. All of the remaining data stored on Sytos cartridges were transferred to the M.O. disk, making the Northwest system independent of the Sytos Backup System, which was removed from the system.

8th Quarter:

1. Dr. Alv Egland from the University of Oslo (GL visiting scientist) had a video tape from the ISIT B camera in Ny Alesund that he wanted processed. A parameter file was created and the data processed. A large portion of the data set was photographed onto 35mm film, and processed by the Photo Lab.

2. Dr. Fukui requested processing of some of his Qaanaaq data (film-based medium). It was necessary to first digitize the data using the film transport system

associated with the Northwest System. A parameter file for the data was constructed and the data processed. Photographs of specific events were processed on the Rembrandt camera system (Polaroid film), see Appendix F. The data were finally stored on an M.O disk.

9th Quarter:

1. A large-scale project was undertaken to transfer all raw data stored on magnetic tape to M.O. disk (from many different campaigns over the previous 5 years or so). These data could be stored on a relatively small number of disks compared to the hundreds of magnetic tapes, with greatly improved file management and accessibility. Also, all data will be in the same format as the more recent ASIP II format, and the Northwest Data Analysis System will be independent of the Kennedy tape drive units. This conversion was completed by the end of the quarter.

10th Quarter:

1. One of our existing data analysis programs, Geoplot, was modified and new features were added, such as latitude and longitude labeling. A batch file processing system was developed to facilitates the conversion of ASIP II data files into the Image Technology format used by the Northwest system; each file's header information is read and overlaid onto the converted image. The converted data is then stored on the Northwest system's hard disk.

2. This utility was then used to analyze and process data from a January 1992, Spitzbergen campaign. Dr. Weber requested some particle spectral density plots, which were run on the Cyber.

3. It became necessary to retrieve large amounts of images from a film-based medium. The computer control for the Film Transport was not functioning, so the necessary repairs were made. A computer-automation utility was written for the Film Transport System so that it is able to continuously retrieve consecutive images from film, digitize the images, and store them on Northwest System's hard disk, see Appendix H.

11th Quarter:

1. During this quarter, image processing support was provided to various individuals associated with Philips Laboratory. Dr. Valladares, from Boston College, requested assistance in digitizing his film-based images using our film transport system. Hugh Gallagher (Boston College) also needed assistance in facilitating his analysis of February 1991 Sondrestrom data. Some of these data

needed to be processed in association with radar data, with radar velocity vector information being overlaid onto the transformed images.

2. A study of convecting auroral patch structures was begun (Dr. Weber and Hugh Gallagher) using the February 1992 Sondrestrom data. The objective was to look at images taken at 6300 A and 5577 A at the same time, to search for a spatial shift in the leading edges of the patches.

12th Quarter:

1. The patch study was continued, with a particularly promising event on February 25, 1992 selected for detailed analysis. The data set includes optical data from ASIP II, photometer data, and radar data.

2. Analysis of the July 1992 CRRES campaign data has begun. Dr. Groves requested hard-copy prints of specific time periods. The data were converted from ASIP II format into ITT format, photographed, and stored on the M.O. disk.

5. Scientific Consulting:

During this Contract, Dr. M. Kelley (Cornell University) was retained as a consultant. He has a wide ranging background in the study of ionospheric irregularities and active experiments, as well as close ties to the NSF and NASA communities working in these research areas.

Dr. Kelley became involved with the RODEO Project, which evolved from his idea to create a fiducial on the ASIP II images that corresponded with the instantaneous look-angle of the Sondre Stromfjord radar.

Dr. Kelley was also involved in the decision process concerning the so-called southern launch site in Puerto Rico, and kept PL updated on its implications for the project. The final decision to cancel the site was made with minimal friction because of the open communications channel that Dr. Kelley facilitated. Similarly, the resultant fielding of the FAR radar resulted from the early realization on the implications of the southern launch site cancellation.

Dr. Kelley also been involved in evolving projects such as HAARP, OTH and GPS. In the former case, he is considering such issues as the Operations Center, the Powerful Diagnostics Radar, and the general structure of the diagnostic campaigns both currently and in the future. With the OTH effort, his background in equatorial and spread-F research with enhance the PL effort. In the GPS area, he has identified a well-documented case of GPS outage due to equatorial spread-F in the Pacific sector, and provided these data to Phillips Laboratory.

6. Procurement:

Equipment items purchased under this Contract were as follows:

1 Thorne EMI photomultiplier tube
1 Kearsage Universal Timer
4 Varo 25mm Gen II image intensifiers
1 Imaging Technology frame grabber board
1 APT optical disc drive
2 ATS electronic rack shipping cases
1 Labsphere diffuse white reflector
1 Sony VHS VCR and Sony color monitor
1 Pika Tech AVA-2T board
1 Automax camera drive motor/clutch
2 Melles Griot shutters

7. Personnel:

Personnel working on this Contract were as follows:

Principal Investigator:	Robert H. Eather
Engineers:	Peter Ning
	Cyril Lance (Consultant)
	D. Pingal (Consultant)
Technician:	Terry Elthon
Data Analyst:	Marlene Colerico (Consultant)
Consulting Scientist:	Michael Kelley (Consultant)

8. Travel:

The following lists travel of Keo personnel in support of this Contract:

Dates	Personnel	Location	Purpose
4/14/90- 4/27/90	P. Ning T. Elthon	Lincoln, MA	Field Support
10/8/90- 10/24/90	P. Ning T. Elthon	Sondrestrom, Greenland	Field Support
11/1/90- 11/2/90	P. Ning T. Elthon	Dover AFB, MD	Field Support
12/10/90- 12/19/90	P. Ning T. Elthon	Sondrestrom, Greenland	Field Support
1/15/91- 1/18/91	P. Ning	Wright Patterson AFB, OH	Flight Training
2/4/91- 2/20/91	P. Ning	Sondrestrom, Greenland	Field Support
4/9/91- 4/11/91	R. Eather	Las Vegas, Nevada	NAB Conference (partial support)
6/27/91- 6/30/91	P. Ning	London, Ontario, Canada	Radar School
6/24/91- 6/26/91	P. Ning	Pease AFB, NH	Aircraft Prep.
7/8/91- 7/26/91	P. Ning	Aruba, Netherlands	CRRES Campaign

Dates	Personnel	Location	Purpose
10/27/91- 11/15/91	P. Ning	Sondrestrom, Greenland	Field Support
12/16/91- 1/12/92	P. Ning	Longyearbyen, Spitsbergen	Field Support
2/19/92- 3/10/92	P. Ning	Sondrestrom, Greenland	Field Support
3/17/92 3/19/92	P. Ning	Wallops Is., VA	CRRES Meeting
5/17/92- 5/21/92	P. Ning	SAC HQ, Offutt AFB, NE	Demonstrate Remote Access SDRS
6/25/92- 7/14/92	P. Ning C. Lance	Aguadilla, Puerto Rico	Field Support
	A. Cameron	Antigua	Field Support
8/22/92- 8/28/92	P. Ning	AFSPACECOM HQ Offutt AFB, NE	Demo Remote Access SDRS
9/20/92- 9/25/92	P. Ning	Peterson AFB, CO	Demo Remote Access SDRS

Table 1

I= 1	AZ= 0.00	EL= 90.00
I= 2	AZ= 1.41	EL= 88.59
I= 3	AZ= 2.82	EL= 87.18
I= 4	AZ= 4.24	EL= 85.76
I= 5	AZ= 5.65	EL= 84.35
I= 6	AZ= 7.06	EL= 82.94
I= 7	AZ= 8.47	EL= 81.53
I= 8	AZ= 9.88	EL= 80.12
I= 9	AZ= 11.29	EL= 78.71
I= 10	AZ= 12.71	EL= 77.29
I= 11	AZ= 14.12	EL= 75.88
I= 12	AZ= 15.53	EL= 74.47
I= 13	AZ= 16.94	EL= 73.06
I= 14	AZ= 18.35	EL= 71.65
I= 15	AZ= 19.76	EL= 70.24
I= 16	AZ= 21.18	EL= 68.82
I= 17	AZ= 22.59	EL= 67.41
I= 18	AZ= 24.00	EL= 66.00
I= 19	AZ= 25.41	EL= 64.59
I= 20	AZ= 26.82	EL= 63.18
I= 21	AZ= 28.24	EL= 61.76
I= 22	AZ= 29.65	EL= 60.35
I= 23	AZ= 31.06	EL= 58.94
I= 24	AZ= 32.47	EL= 57.53
I= 25	AZ= 33.88	EL= 56.12
I= 26	AZ= 35.29	EL= 54.71
I= 27	AZ= 36.71	EL= 53.29
I= 28	AZ= 38.12	EL= 51.88
I= 29	AZ= 39.53	EL= 50.47
I= 30	AZ= 40.94	EL= 49.06
I= 31	AZ= 42.35	EL= 47.65
I= 32	AZ= 43.76	EL= 46.24
I= 33	AZ= 45.18	EL= 44.82
I= 34	AZ= 46.59	EL= 43.41
I= 35	AZ= 48.00	EL= 42.00
I= 36	AZ= 49.41	EL= 40.59
I= 37	AZ= 50.82	EL= 39.18
I= 38	AZ= 52.24	EL= 37.76
I= 39	AZ= 53.65	EL= 36.35
I= 40	AZ= 55.06	EL= 34.94
I= 41	AZ= 56.47	EL= 33.53
I= 42	AZ= 57.88	EL= 32.12
I= 43	AZ= 59.29	EL= 30.71
I= 44	AZ= 60.71	EL= 29.29
I= 45	AZ= 62.12	EL= 27.88
I= 46	AZ= 63.53	EL= 26.47
I= 47	AZ= 64.94	EL= 25.06
I= 48	AZ= 66.35	EL= 23.65
I= 49	AZ= 67.76	EL= 22.24
I= 50	AZ= 69.18	EL= 20.82
I= 51	AZ= 70.59	EL= 19.41
I= 52	AZ= 72.00	EL= 18.00
I= 53	AZ= 73.41	EL= 16.59
I= 54	AZ= 74.82	EL= 15.18
I= 55	AZ= 76.24	EL= 13.76
I= 56	AZ= 77.65	EL= 12.35
I= 57	AZ= 79.06	EL= 10.94
I= 58	AZ= 80.47	EL= 9.53
I= 59	AZ= 81.88	EL= 8.12
I= 60	AZ= 83.29	EL= 6.71
I= 61	AZ= 84.71	EL= 5.29
I= 62	AZ= 86.12	EL= 3.88
I= 63	AZ= 87.53	EL= 2.47
I= 64	AZ= 88.94	EL= 1.06
I= 65	AZ= 90.35	EL= -0.35
I= 66	AZ= 91.76	EL= -1.76
I= 67	AZ= 93.18	EL= -3.18
I= 68	AZ= 94.59	EL= -4.59
I= 69	AZ= 96.00	EL= -6.00
I= 70	AZ= 97.41	EL= -7.41
I= 71	AZ= 98.82	EL= -8.82
I= 72	AZ= 100.24	EL= -10.24
I= 73	AZ= 101.65	EL= -11.65
I= 74	AZ= 103.06	EL= -13.06
I= 75	AZ= 104.47	EL= -14.47
I= 76	AZ= 105.88	EL= -15.88
I= 77	AZ= 107.29	EL= -17.29
I= 78	AZ= 108.71	EL= -18.71
I= 79	AZ= 110.12	EL= -20.12
I= 80	AZ= 111.53	EL= -21.53
I= 81	AZ= 112.94	EL= -22.94
I= 82	AZ= 114.35	EL= -24.35
I= 83	AZ= 115.76	EL= -25.76
I= 84	AZ= 117.18	EL= -27.18
I= 85	AZ= 118.59	EL= -28.59
I= 86	AZ= 120.00	EL= -30.00
I= 87	AZ= 121.41	EL= -31.41
I= 88	AZ= 122.82	EL= -32.82
I= 89	AZ= 124.24	EL= -34.24
I= 90	AZ= 125.65	EL= -35.65
I= 91	AZ= 127.06	EL= -37.06
I= 92	AZ= 128.47	EL= -38.47
I= 93	AZ= 129.88	EL= -39.88
I= 94	AZ= 131.29	EL= -41.29
I= 95	AZ= 132.71	EL= -42.71
I= 96	AZ= 134.12	EL= -44.12
I= 97	AZ= 135.53	EL= -45.53
I= 98	AZ= 136.94	EL= -46.94
I= 99	AZ= 138.35	EL= -48.35
I= 100	AZ= 139.76	EL= -49.76
I= 101	AZ= 141.18	EL= -51.18
I= 102	AZ= 142.59	EL= -52.59
I= 103	AZ= 144.00	EL= -54.00
I= 104	AZ= 145.41	EL= -55.41
I= 105	AZ= 146.82	EL= -56.82
I= 106	AZ= 148.24	EL= -58.24
I= 107	AZ= 149.65	EL= -59.65
I= 108	AZ= 151.06	EL= -61.06
I= 109	AZ= 152.47	EL= -62.47
I= 110	AZ= 153.88	EL= -63.88
I= 111	AZ= 155.29	EL= -65.29
I= 112	AZ= 156.71	EL= -66.71
I= 113	AZ= 158.12	EL= -68.12
I= 114	AZ= 159.53	EL= -69.53
I= 115	AZ= 160.94	EL= -70.94
I= 116	AZ= 162.35	EL= -72.35
I= 117	AZ= 163.76	EL= -73.76
I= 118	AZ= 165.18	EL= -75.18
I= 119	AZ= 166.59	EL= -76.59
I= 120	AZ= 168.00	EL= -78.00
I= 121	AZ= 169.41	EL= -79.41
I= 122	AZ= 170.82	EL= -80.82
I= 123	AZ= 172.24	EL= -82.24
I= 124	AZ= 173.65	EL= -83.65
I= 125	AZ= 175.06	EL= -85.06
I= 126	AZ= 176.47	EL= -86.47
I= 127	AZ= 177.88	EL= -87.88
I= 128	AZ= 179.29	EL= -89.29
I= 129	AZ= 180.71	EL= 0.00
I= 130	AZ=-177.88	EL= 0.00
I= 131	AZ=-176.47	EL= 0.00
I= 132	AZ=-175.06	EL= 0.00
I= 133	AZ=-173.65	EL= 0.00
I= 134	AZ=-172.24	EL= 0.00
I= 135	AZ=-170.82	EL= 0.00
I= 136	AZ=-169.41	EL= 0.00
I= 137	AZ=-168.00	EL= 0.00
I= 138	AZ=-166.59	EL= 0.00
I= 139	AZ=-165.18	EL= 0.00
I= 140	AZ=-163.76	EL= 0.00
I= 141	AZ=-162.35	EL= 0.00
I= 142	AZ=-160.94	EL= 0.00
I= 143	AZ=-159.53	EL= 0.00
I= 144	AZ=-158.12	EL= 0.00
I= 145	AZ=-156.71	EL= 0.00
I= 146	AZ=-155.29	EL= 0.00
I= 147	AZ=-153.88	EL= 0.00
I= 148	AZ=-152.47	EL= 0.00
I= 149	AZ=-151.06	EL= 0.00
I= 150	AZ=-149.65	EL= 0.00
I= 151	AZ=-148.24	EL= 0.00
I= 152	AZ=-146.82	EL= 0.00
I= 153	AZ=-145.41	EL= 0.00
I= 154	AZ=-144.00	EL= 0.00
I= 155	AZ=-142.59	EL= 0.00
I= 156	AZ=-141.18	EL= 0.00
I= 157	AZ=-139.76	EL= 0.00
I= 158	AZ=-138.35	EL= 0.00
I= 159	AZ=-136.94	EL= 0.00
I= 160	AZ=-135.53	EL= 0.00
I= 161	AZ=-134.12	EL= 0.00
I= 162	AZ=-132.71	EL= 0.00

I= 163 AZ=-131.29 EL= 0.00
I= 164 AZ=-129.88 EL= 0.00
I= 165 AZ=-128.47 EL= 0.00
I= 166 AZ=-127.06 EL= 0.00
I= 167 AZ=-125.65 EL= 0.00
I= 168 AZ=-124.24 EL= 0.00
I= 169 AZ=-122.82 EL= 0.00
I= 170 AZ=-121.41 EL= 0.00
I= 171 AZ=-120.00 EL= 0.00
I= 172 AZ=-118.59 EL= 0.00
I= 173 AZ=-117.18 EL= 0.00
I= 174 AZ=-115.76 EL= 0.00
I= 175 AZ=-114.35 EL= 0.00
I= 176 AZ=-112.94 EL= 0.00
I= 177 AZ=-111.53 EL= 0.00
I= 178 AZ=-110.12 EL= 0.00
I= 179 AZ=-108.71 EL= 0.00
I= 180 AZ=-107.29 EL= 0.00
I= 181 AZ=-105.88 EL= 0.00
I= 182 AZ=-104.47 EL= 0.00
I= 183 AZ=-103.06 EL= 0.00
I= 184 AZ=-101.65 EL= 0.00
I= 185 AZ=-100.24 EL= 0.00
I= 186 AZ= -98.82 EL= 0.00
I= 187 AZ= -97.41 EL= 0.00
I= 188 AZ= -96.00 EL= 0.00
I= 189 AZ= -94.59 EL= 0.00
I= 190 AZ= -93.18 EL= 0.00
I= 191 AZ= -91.76 EL= 0.00
I= 192 AZ= -90.35 EL= 0.00
I= 193 AZ= -88.94 EL= 0.00
I= 194 AZ= -87.53 EL= 0.00
I= 195 AZ= -86.12 EL= 0.00
I= 196 AZ= -84.71 EL= 0.00
I= 197 AZ= -83.29 EL= 0.00
I= 198 AZ= -81.88 EL= 0.00
I= 199 AZ= -80.47 EL= 0.00
I= 200 AZ= -79.06 EL= 0.00
I= 201 AZ= -77.65 EL= 0.00
I= 202 AZ= -76.24 EL= 0.00
I= 203 AZ= -74.82 EL= 0.00
I= 204 AZ= -73.41 EL= 0.00
I= 205 AZ= -72.00 EL= 0.00
I= 206 AZ= -70.59 EL= 0.00
I= 207 AZ= -69.18 EL= 0.00
I= 208 AZ= -67.76 EL= 0.00
I= 209 AZ= -66.35 EL= 0.00
I= 210 AZ= -64.94 EL= 0.00
I= 211 AZ= -63.53 EL= 0.00
I= 212 AZ= -62.12 EL= 0.00
I= 213 AZ= -60.71 EL= 0.00
I= 214 AZ= -59.29 EL= 0.00
I= 215 AZ= -57.88 EL= 0.00
I= 216 AZ= -56.47 EL= 0.00
I= 217 AZ= -55.06 EL= 0.00
I= 218 AZ= -53.65 EL= 0.00
I= 219 AZ= -52.24 EL= 0.00
I= 220 AZ= -50.82 EL= 0.00
I= 221 AZ= -49.41 EL= 0.00
I= 222 AZ= -48.00 EL= 0.00
I= 223 AZ= -46.59 EL= 0.00
I= 224 AZ= -45.18 EL= 0.00
I= 225 AZ= -43.76 EL= 0.00
I= 226 AZ= -42.35 EL= 0.00
I= 227 AZ= -40.94 EL= 0.00
I= 228 AZ= -39.53 EL= 0.00
I= 229 AZ= -38.12 EL= 0.00
I= 230 AZ= -36.71 EL= 0.00
I= 231 AZ= -35.29 EL= 0.00
I= 232 AZ= -33.88 EL= 0.00
I= 233 AZ= -32.47 EL= 0.00
I= 234 AZ= -31.06 EL= 0.00
I= 235 AZ= -29.65 EL= 0.00
I= 236 AZ= -28.24 EL= 0.00
I= 237 AZ= -26.82 EL= 0.00
I= 238 AZ= -25.41 EL= 0.00
I= 239 AZ= -24.00 EL= 0.00
I= 240 AZ= -22.59 EL= 0.00
I= 241 AZ= -21.18 EL= 0.00
I= 242 AZ= -19.76 EL= 0.00
I= 243 AZ= -18.35 EL= 0.00
I= 244 AZ= -16.94 EL= 0.00
I= 245 AZ= -15.53 EL= 0.00
I= 246 AZ= -14.12 EL= 0.00
I= 247 AZ= -12.71 EL= 0.00
I= 248 AZ= -11.29 EL= 0.00
I= 249 AZ= -9.88 EL= 0.00
I= 250 AZ= -8.47 EL= 0.00
I= 251 AZ= -7.06 EL= 0.00
I= 252 AZ= -5.65 EL= 0.00
I= 253 AZ= -4.24 EL= 0.00
I= 254 AZ= -2.82 EL= 0.00
I= 255 AZ= -1.41 EL= 0.00
I= 256 AZ= 0.00 EL= 0.00

Table 2

This file - D:\NING\NOTES\EARTHRAD.TXT

THE EARTH'S RADIUS AT SONDRESTROM, AND MORE ...
===

Calculated from:

Radius = Earthnom * (0.99832 + 0.00168 * cos (2 * lat)),

where Earthnom = 6378.14 km

Lat: 90.0 degrees	Radius: 6356.7095 km
Lat: 85.0 degrees	Radius: 6356.8721 km
Lat: 80.0 degrees	Radius: 6357.3555 km
Lat: 75.0 degrees	Radius: 6358.1450 km
Lat: 70.0 degrees	Radius: 6359.2163 km
Lat: 65.0 degrees	Radius: 6360.5371 km
Lat: 60.0 degrees	Radius: 6362.0669 km
Lat: 55.0 degrees	Radius: 6363.7598 km
Lat: 50.0 degrees	Radius: 6365.5640 km
Lat: 45.0 degrees	Radius: 6367.4248 km
Lat: 40.0 degrees	Radius: 6369.2856 km
Lat: 35.0 degrees	Radius: 6371.0894 km
Lat: 30.0 degrees	Radius: 6372.7822 km
Lat: 25.0 degrees	Radius: 6374.3125 km
Lat: 20.0 degrees	Radius: 6375.6333 km
Lat: 15.0 degrees	Radius: 6376.7046 km
Lat: 10.0 degrees	Radius: 6377.4937 km
Lat: 5.0 degrees	Radius: 6377.9771 km
Lat: 0.0 degrees	Radius: 6378.1401 km

For Sondrestrom SRI Radar Site at 66 59' 12" lat --> 66.9867
309 03' 02" lon --> 309.0506

and 180 meters above sea level we have as the earth's radius there:

6359.9849 + 0.180 = 6360.1649 km

Fig. 1 - Old Text Display Format

Fig. 2 - New Text Display Format

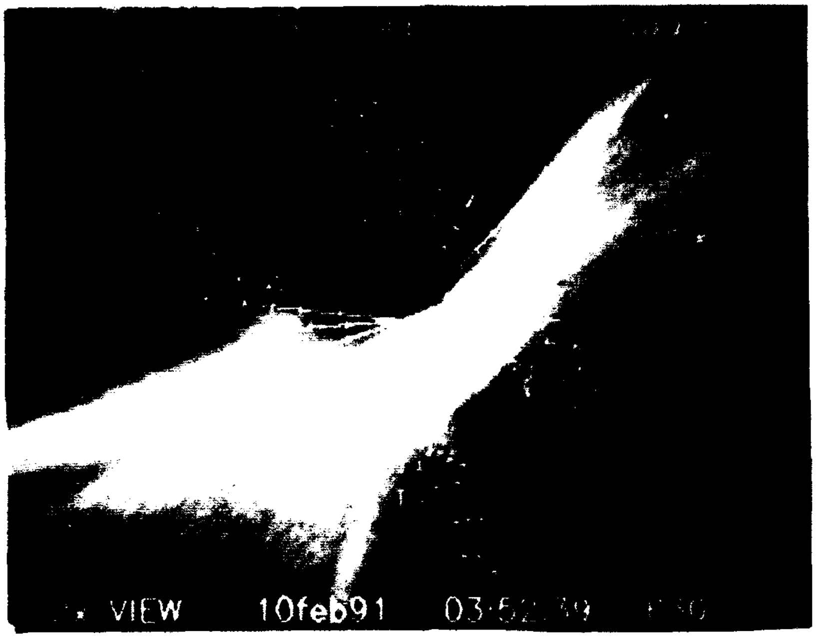

Fig. 3 - Radar Velocity Vector Plot (white vectors)

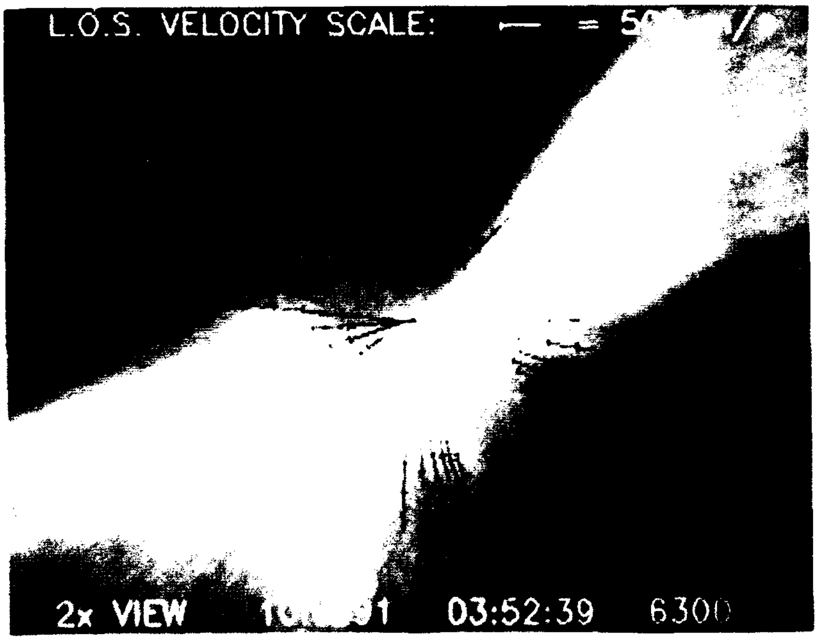

Fig. 4 - Radar Velocity Vector Plot (black vectors)

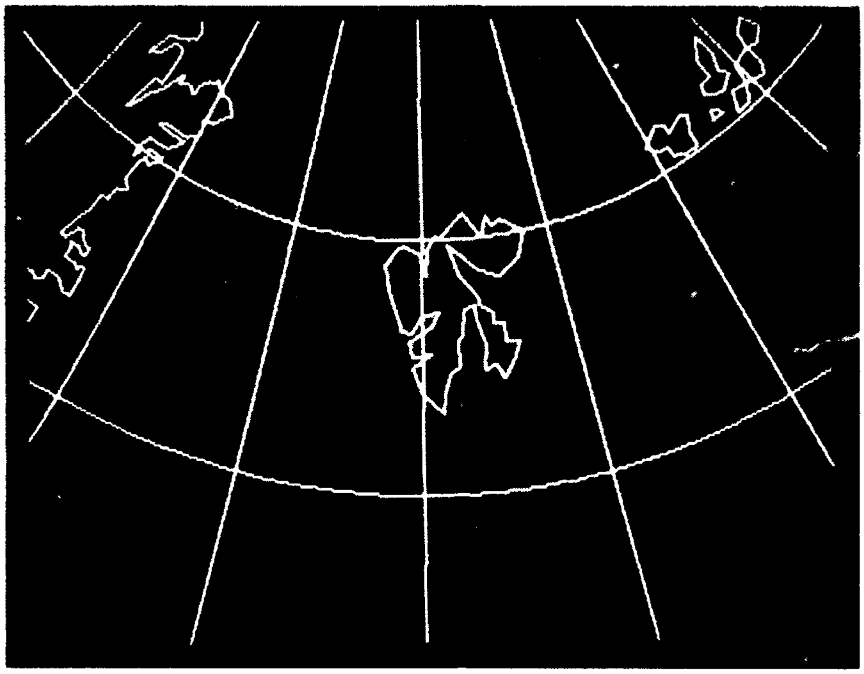

Fig. 5 - Grid Overlay Example

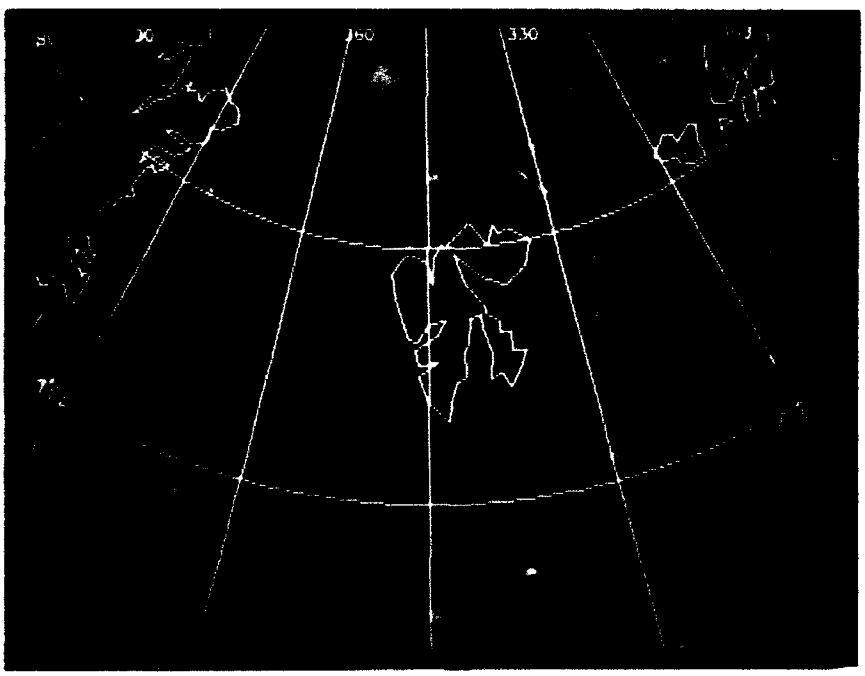

Fig. 6 - Grid Overlay with Lat/Long Labels

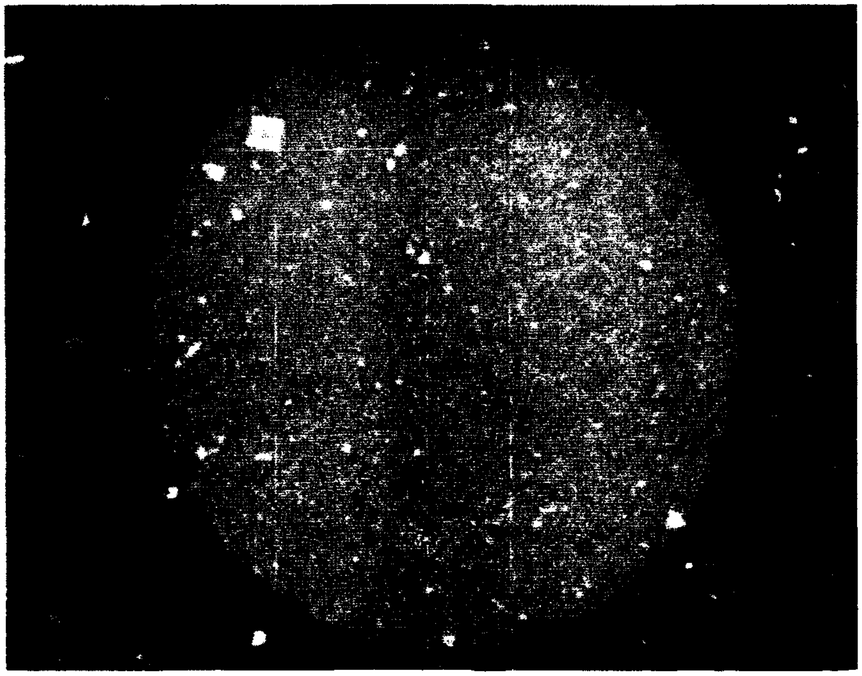

Fig. 7 - Uniform Source Image To Test Vignetting Correction

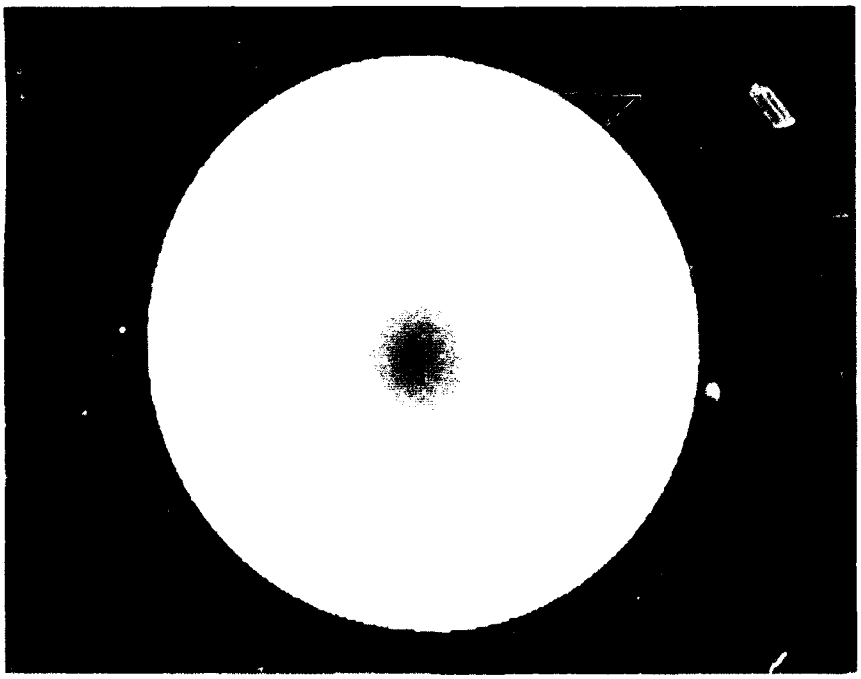

Fig. 8 - Vignetting Correction on Uniform Source Image

Fig. 9 - Data Image To Test Vignetting Correction

Fig. 10 - Vignetting Correction on Data Image

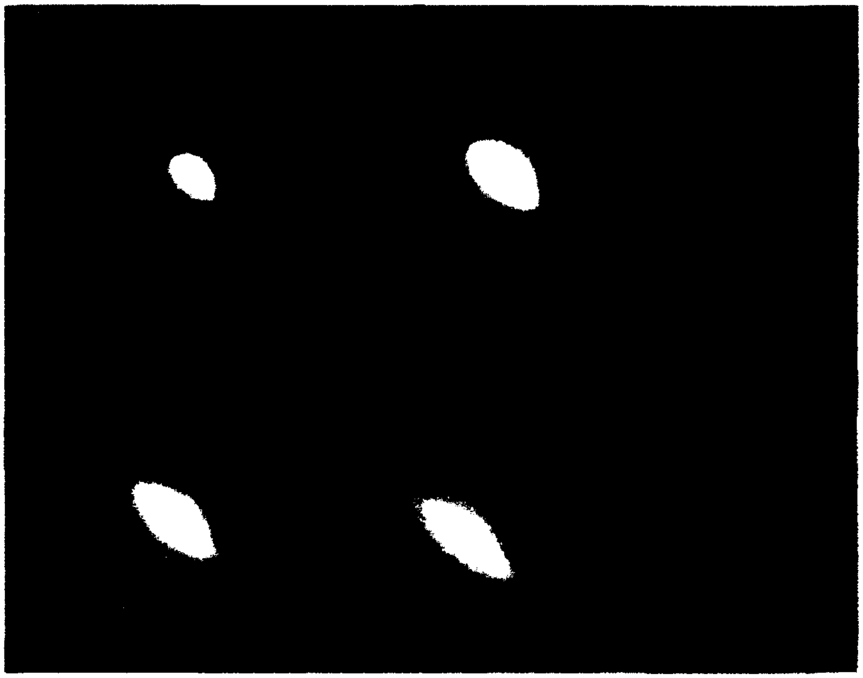

Fig. 11 - MIP Display of CRRES Barium Release

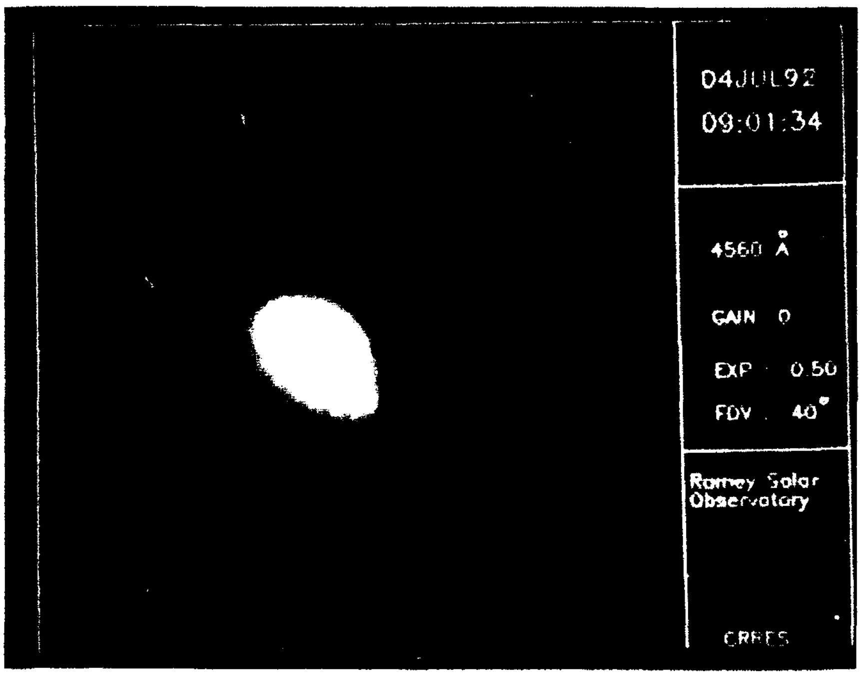

Fig. 12 - Pixel (1/1 to 5/4) Conversion of MIP Image Displayed on IIPS

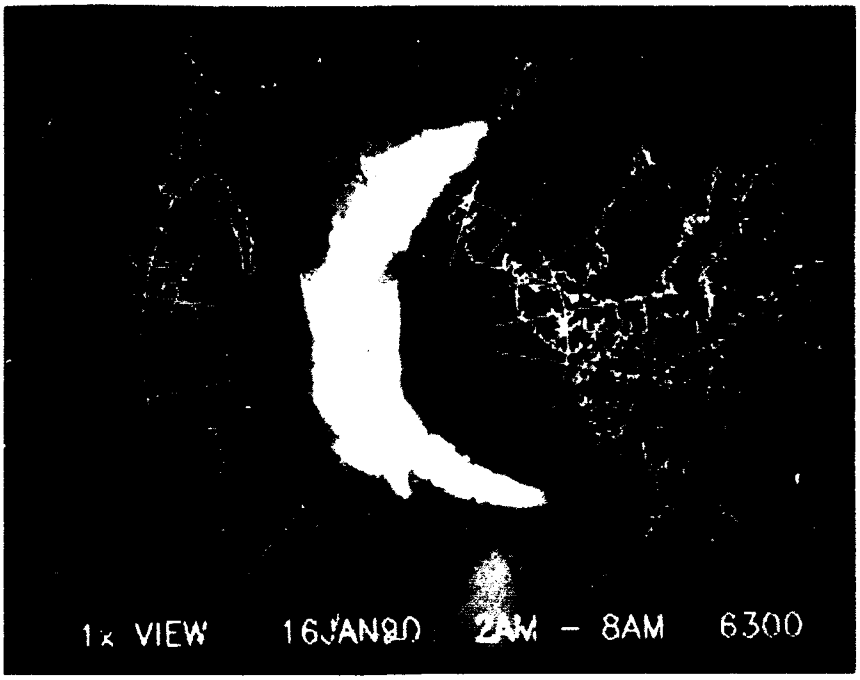

Fig. 13 - Composite AIO Flight Track View of ASIP-I Images (Pixel AND)

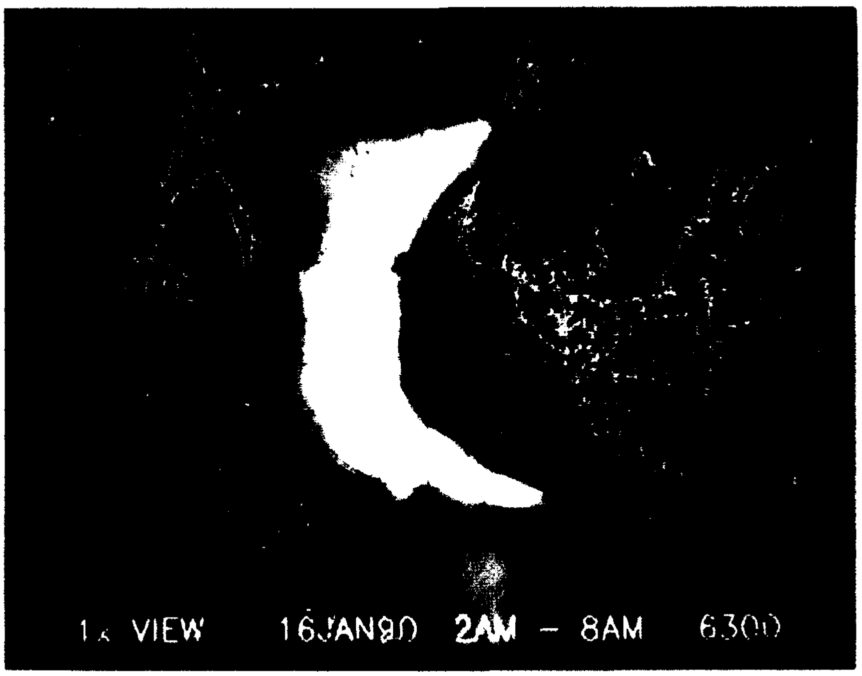

Fig. 14 - Composite AIO Flight Track View of ASIP-I Images (Pixel OR)

APPENDIX A

This file: "D:\NING\NOTES\ASIPCAL.TXT" last modified: 28AUG91

Calibration/Verification of ASIP-II Images to Northwest's IIPS.

==

- Pixel center on ASIP II: X=131, Y=135 (2 x 2 binning)
- Cursor at ASIP(131,135) snapped into IIPS frame grabber board.
- Cursor in OMNI wound up at: X=253 and Y=253.
- A recorded image of cursor via Timebase Corrector and Panasonic optical disk did not deviate cursor position when snapped into OMNI.
- Prior parameter files, SONDE4.PAR,SONDE5.PAR,SONDE6.PAR used X=259, Y=264
  as image centers. This error translated through the OMNI transformation as:
  OMNI(253,253) --> transformation --> OMNI(255,240)
  OMNI(259,264) --> transformation --> OMNI(256,242)

Output deviation is 2 pixels or less due to pixel compression at the zenith during the transformation process.

- Image Boundary (y-pix-diam) determined with a snapped grid from ASIP II. The outermost ring corresponds to the edge of the camera's 180 deg FOV.
- IIPS PARAMETERS (with values for Sondrestrom Ground Setup):

mop	512	ior.x	width of output raster (pixels)
nop	480	ior.y	height of output raster (pixels)
iopoff	0	ioroff.x	upper-left corner of viewport (pixels)
jopoff	0	ioroff.y	upper-left corner of viewport (pixels)
ioplen	512	iorlen.x	width of viewport (pixels)
joplen	480	iorlen.y	height of viewport (pixels)
xoplen	10.0	dorlen.x	width of output raster (inches)
yoplen	7.5	dorlen.y	height of output raster (inches)
xp	5.0	polor.x	horizontal offset of pole; xp = xoplen/2

yp	-5.9753	polor.y	vertical offset of pole yp = (yoplen/2) - (90-latc)/dedrop
dedrop	2.3663		rate of elevation change (deg/user units) dedrop = rfov-arcsin(rade/(rade+hion)*sin(rfov)) / (yoplen/2 - border) Historically, border = 0.1 inches. *** NOTE: For common grid overlay scaling between different filters, dedrop must be identical and calculated with the maximum hion value, normally at 6300A->250km.
aopr	-399.0506		angle, zero meridian vs. x axis, right is pos. aopr = -90 - lonc
proj	0		0 = polar plot, 1 = Cartesian plot
rade	6360.1649		radius of earth (km)
hion	250.0 or 130.0 or 110.0		altitude of ionosphere (km) usually 6300A->250km, 5577A->130km, 4278A->110km
latm	90.0	lato	latitude of origin of output plane
lonm	0.0	lono	longitude of origin of output plane
latc	66.9867		latitude of camera site (degrees)
lonc	309.0506		longitude of camera site (degrees) Sondrestrom: 66 59' 12" lat, 309 03' 02" lon
caxisel	90.0	easza	elevation of camera axis relat (degrees)
caxisaz	0.0	aasza	azimuth of camera axis
rfov	80.0		radius of camera field of view ASIP II 180 FOV lens with 10 deg crop = 80

xiplen	10.0	dirlen.x	width of the input raster (user units)
yiplen	7.5	dirlen.y	height of the input raster (user units)
polirx	4.9414	polir.x	horizontal position of the camera axis (x-pixel-center = 253) * xiplen / mip
poliry	3.9531	polir.y	vertical position of the camera axis (y-pixel-center = 253) * yiplen / nip
dedrip	24.1004		rate of change, elevation vs latitude = (2*(rfov+crop))/(y-pix-diam * yiplen/jiplen) *** NOTE: y-pix-diam = 478
aipr	270		angle, azimuth to radius parallel aipr = 270 - (camera rotation from N clockwise)
mip	512	iir.x	width of input raster (pixels)
nip	480	iir.y	height of input raster (pixels)
iipoff	0	iiroff.x	horizontal offset of input subimage
jipoff	0	iiroff.y	vertical offset of input subimage
iiplen	512	irrlen.x	width of input subimage (pixels)
jiplen	480	iirlen.y	height of input subimage (pixels)
avethresh	1	navthr	number of samples to be smoothed

inimagefile	"E:\DDMMMYY\HHMMSSF.IMG"	name of input image file
outimagefile	"F:\DDMMMYY\HHMMSSF.OUT"	name of output image file
smthdatfile	""	smoothing schedule file (if any)
resdatfile	"D:\NW_UTILS\RES\LOC_FILT.RES"	resampling schedule file (if any)

- Parameter Changes for Aircraft (Flying at 10km) Images :

Constants:	dedrop	2.2926	different rade,hion, & rfov
	rade	6370.1649	+10km for aircraft avg altitude
	hion	240.0	-10km for 6300A
		120.0	-10km for 5577A

100.0		-10km for 4278A
rfov	80.0	ASIP I with crop = 10 deg
polirx	5.0195	y-pix-diam = 460, x = 257
poliry	3.7188	y-pix-diam = 460, y = 238
dedrip	25.0435	y-pix-diam = 460

Variables: Dependancy on lat-lon & bearing for each image
latc,lonc,yp,aopr,aipr

- For Composite Aircraft Image with 3" Circles:

dedrop	5.5787	
yp	3.75	(for North Pole centered image)
aopr	-90.0	

Modify D:\NING\C\NWBATCH.C such that yp and aopr are fixed.

- For Steve Mende's All-sky Imaging System at Sondrestrom:

Constant:	rfov	70.0	All-sky with crop = 20 deg
	polirx	5.4102	y-pix-diam = 372, x = 277
	poliry	3.8438	y-pix-diam = 372, y = 246
	dedrip	30.9677	y-pix-diam = 372

- FOR Polar Arcs 1987 Data

center(217, 240) r = 270 d = 540

polirx	4.23828	
poliry	3.75	** yp and dedrop change with variations
dedrip	21.333	in RFOV *****

*** NOTE - GRID OVERLAYS CANNOT BE PRODUCED FOR RFOV < 73 degrees ***
*** THAT IS A DEDROP < = 1.5 **

APPENDIX B

Using the contour command files ...

init.cmd - Initializes all contour variables. This should be the first command file to execute to define and set the default variables.

red.cmd - Sets a contour with a minimum value specified by
green.cmd the variable "min" and the band size with variable "band"
blue.cmd

rgb.cmd - Sets a composite contour of three colors with bands specified by the variables:
rmin,rband,
gmin,gband,
bmin,bband

For example, you want a composite band with the following mapping:
red 0 - 75
green 100 - 150
blue 200 - 255, then type

```
comfile init.cmd
vassign rmin 0
vassign rband 76
vassign gmin 100
vassign gband 51
vassign bmin 200
vassign bband 56
comfile rgb.cmd
```

For only one color, say green we wand a band between 75 150, type

```
comfile init.cmd
vassign min 75
vassign band 76
comfile green.cmd
```

*** Note: Make sure you are in the D:\NW_UTILS\CONTOUR directory when executing the command files. You should change the directory with the "DOS" command after loading the omni system from the "C:\IMAGED\ASIP" directory.

APPENDIX C

MS-DOS file system words for IoForth - 11 jan 90 dbp

"User" words (the top):

fdr --- filename,

read image file <filename> from disk into the current image.

fdw --- filename,

write the current image to disk.

basename --- filename,

use <filename> as the base for below:

getbase --- ,

prompt user to enter a file name, use it as the base for below:

odr n ---,

read current image from file <basename.nnn>

odw n ---,

write current image to file <basename.nnn>

oformat ---,

format the disk.

omd --- dirname,

make new directory

ocd --- dirname,

grabs dirname from the input stream; changes to it, if possible.

odel --- filename,

remove <filename> from the disk

odelall ---,

remove all files in the current directory

oren --- oldname newname,

rename file from oldname to newname

odir ---,

display names of all files in the current directory.

ofree ---,
display amount of free space on current disk, in bytes.

The rest of the system, in order defined:

<mord > addr blk #blks ---,
reads #blks sectors starting at blk from the disk into memory at addr

<mowr > addr blk #blks ---,
writes #blks sectors starting at blk to the disk from memory at addr

i@ addr ---, n
fetches an Intel integer (16 bits, backwards byte order) from memory at addr.

i! n addr ---,
stores an Intel integer (16 bits, backwards byte order) into memory at addr.

il@ addr ---, n
fetches an Intel long (32 bits, really backwards byte order) from memory at addr.

il! n addr ---,
stores an Intel long (32 bits, backwards byte order) into memory at addr.

sect_size constant
number of bytes per sector (block).

sects/clust constant
number of sectors per cluster.

clust_size constant
number of bytes per cluster, computed at compile time from the above two constants.

fatorg constant
absolute block address on the disk of the start of the first File Allocation Table.

fat_sects constant
number of sectors per FAT.

clusters constant
total number of clusters on the disk.

rootdir constant

absolute block address on the disk of the start of the root directory.

rootend constant

absolute block address on the disk of the end of the root directory; i.e. start of the data area.

root_sects constant

number of sectors in the root directory.

fat_eof constant

what gets put in the last cluster of each files FAT chain, to mark it as the end.

fat_buf variable

A 1 sector buffer contains a sector of the FAT for working storage.

fat_ptr variable

Contains the block number of what's in fat_buf.

fat_dirty variable

If non-zero, the contents of fat_buf have been changed and should be written back to the disk.

wrfat ---,

writes the contents of fat_buf to disk if necessary.

rdfat blk ---,

reads sector blk into fat_buf.

fat@ adr ---, clust

gets the contents of FAT entry number adr.

fat! clust adr ---,

puts clust into the contents of FAT entry number adr.

fatlist adr ---,

lists all of the cluster numbers in the FAT chain starting at adr. Used for debugging.

fsize variable

Gets set to the number of clusters in the most recent file examined by fatend.

fatend clust ---, clust

finds the ending cluster number of the FAT chain starting at clust.

alloc_err variable
set to 1 if space allocation by ffree fails.
free_clust
variable containing the first free cluster from the latest ffree operation. Improves efficiency.
ffree ---, clust
finds a free cluster.
shorten clust cnt ---,
reduces the number of clusters in the FAT chain starting at clust to cnt. The number must be greater than this to begin with.
allocate clust cnt ---,
allocates cnt clusters starting at clust. clust is usually either the beginning of a FAT chain, in the case of a new file; or the end, when increasing the size of one.
flength clust cnt ---,
sets the number of clusters in the chain starting at clust to cnt, regardless of what it was previously.
newfat cnt ---, clust
creates a new FAT chain, and allocates cnt clusters to it. Returns the starting cluster.
rmfat clust ---,
frees all of the clusters in the FAT chain starting at clust.
file@ clust n ---, sect
returns the physical sector number of the nth block within the file starting at clust.
fcb
The file control block (and/or structure of a directory entry) - consists of the following:
fcb_name 8 bytes of filename
fcb_ext 3 bytes of file extension
fcb_attr 1 byte of file attribute
fcb_time 2 bytes of file update time
fcb_date 2 bytes of file date

fcb_blk 2 bytes of starting cluster
fcb_size 4 bytes of file size
success variable
set by <dir_srch> to indicate that the search was successful.
strncmp adr1 adr1 cnt ---, eq
compares cnt bytes starting at adr1 and adr2. Returns eq true if they are equal.
strchr adr cnt c ---, adr
searches for character c in the string at adr and cnt. Returns the address of first match if found, zero otherwise.
fu c1 ---, c2
returns the upper case equivalent of c1 if it is lower case alpha; the character c1 itself otherwise.
alphanum c ---, ?
returns true if c if a letter or number.
?fname ? ---,
prints "Bad file name" error message and aborts if ? is non-zero.
checkfn adr cnt ---,
Modifies the string at adr and cnt to be a valid file name; converts all alpha to upper case, pads the string out with spaces. Prints error message and quits if name can't be so modified.
fparse src n dest ---,
checks whether n byte string at src is a valid file name. If so, converts it into FCB format at dest. If not, calls ?file to complain. Never modifies the source; writes the destination whether successful or not.
getfn --- name,
Gets name from the input stream and fparses it into FCB.
gave_up
variable contains true if the most recent directory search failed because of finding a zeroed directory block; this means there are no more entries in the dir.

success
variable contains true if the most recent directory search succeeded
dir_buf variable
contains a sectors worth of directory currently being accessed.
dir_ptr variable
contains a pointer to the most recently found directory entry in dir_buf.
dir_sect variable
contains the physical block address of the contents of dir_buf.
<dir_srch> ---,
searches what's in dir_buf for a match with the name in FCB. Updates the remainder of FCB, and sets success if a match is found. Sets gave_up if a zero directory entry is found.
current_dir variable
contains the starting cluster number of the current directory or zero if root is the current directory.
cd_sect variable
contains the sector within directort currently being searched.
dirstart ---,
prepares the directory logic to find blocks.
dirnext ---, blk
returns the physical block address of the next sector of the current directory.
<search> ---, found?
searches the current directory for a match with the name in FCB. Updates the remainder of FCB, and sets success if a match is found. Sets gave_up if a zero directory entry is found.
ffind ---, found?
gets a file name from the input stream, and <search>es for it.

?found ? ---,

aborts with a "File not found" error message if ? is non-zero.

wrdir ---,

writes back the (presumably modified) contents of FCB to the disk from whence it came.

file_clust ---, n

computes the number of clusters which should be in a file, n, from the size field in FCB.

erased constant

the magic number used to signify a deleted file.

dirextend ---,

allocates a new block to the current directory and zeroes it, thus extending the subdirectory.

<blfind> ---,

searches dir_buf for an unused entry. Leaves pointers referenced to that entry.

remount ---,

invalidates pointers to all buffers such that the actual data will be read from the disk when required. Used after the disk is changed.

ochange ---,

called at the beginning of all "user" words, checks if the disk has been changed and calls remount if it has.

timestamp ---,

Updates the FCB with the current date and time.

newdir

searches the current directory for an unused entry. Leaves pointers referenced to that entry. If current_dir is not root, extends the subdirectory if no unused entry is found. Otherwise quits with an error message.

?exists ---,

searches for the file name in FCB; aborts with a "File already exists" error message if found.

newfile

requires name, ext, attr, size in fcb - fills in time,

makefn n ---,

Creates a filename in fcb consisting of the name specified by the last basename command with a numeric extension specified by n.

askfn adr cnt ---,

accepts at most cnt characters into a string at adr. Used to read user input when prompted for a file name.

?fnset ---,

aborts with a "Must set base name first" error message if basename has never been set.

date, cluster and writes the dir entry to a blank space

showfn addr ---,

displays the filename (in fcb format) pointed to by addr. Takes care of formatting, doesn't show hidden files.

bss

variable contains a string consisting of "\"; the root directory name.

dotdot

variable contains a string consisting of ".."; the parent directory name.

<chdir> addr n ---,

changes the current directory to that specified in the string by addr and n. Valid directory names consist of either an alphanumeric name of a subdirectory of the current directory; "\", the root directory; or "..", the parent directory if not in the root.

<rm> ---,

erases the file whose name is in FCB.

empty_dir variable

a buffer pre-initialized to the contents of an empty subdirectory. Contains entries for the files "." and "..", as well as a lot of zero entries.

?fsize ---,

checks if file accesses are within the boundaries of the file prints an error message and quits if so.

rdfile addr blk cnt ---,

Reads cnt bytes into addr from block offset blk within file in fcb.

wrfile addr blk cnt ---,

Writes cnt bytes from addr to block offset blk within file in fcb.

imfn varaible

storage for the most recently set basename.

im#base variable

contains the numeric radix for file name creation by makefn.

APPENDIX D

file revlist

\0 list
BLOCK 880 1560 370

```
( ************** Revision List **************** )

The following revision list covers software changes to the
system since the Sondrestrom campaign in Feb '91.  Most
of the changes made were necessary to accommodate the
installation of the 5-position filter wheel and its
controller chassis.  Additionally, an effort was made to clean
up the file system by moving relevant files onto blocks
0-1000 so they would all fit onto one loadable floppy disk.

                          -Peter Ning  27sep91

- Files deleted from dir "camera": calib, mmtape, movie,
  unused, mouse, report, calfix, fdisk, keocal, sgk.
- Files truncated: sc (40->30), ccd (15->10), terplot (50->25),
  init (10->5), plots (10->5), keosys (15-10), keochar (20->10).
```

\1 list
BLOCK 881 1561 371

```
- File "unifor:keobak" deleted.
- File "lplot" moved from camera to unifor, inc block 4->5.
- File "camera:optdsk" increased block 16->20.  File
  "unifor:optdsk-err" moved to blks 16 & 17 of optdsk.
  Blk 2: changed optdsk-error-block from 1250 to 82.
- Moved scmo, comms, msdos from dir unifor to camera.
- File "camera:scmo" truncated from 20->15.
- File "unifor:altaz:7" If plot moved to unifor from camera.
  truncated file 16->10 blocks.
- File "unifor:ldata" expanded from 4->5 blocks.

- "keo:2:port-init": added "3f pgcr c!" for active HI pulse
   for filter position.  Must be asserted AFTER "30 pgcr c!".
- "keo:3:fil": changed mask to 7 from 3 for new 5-pos filter
  wheel.  Also "1-" removed before passing to parallel port.
```

\2 list
BLOCK 882 1562 372

```
- "terplot:1": changed "49 RLOAD" to "24 RLOAD"
- "terplot": Block 25 moved to block 23 prior to file
```

```
truncation from 50->25 blocks.

- "keo:8:gain": "1-" then 2-bit mask for new f.w. controller.
          gain range 1,2,3,4 maps to 0,1,2,3 on hardware.
- "keo:9": kpar changed from 148 to 184 for 5th parameter entry.
       NFILTERS changed 4 -> 5, 7230 added to wavnum.
- "keo:10": added "kpar 148 + constant co5",ex5,de5,mi5,ma5,gn5.
- "keo:11": added "sc5 mi5 @ bmin ! ma5 @ bmax ! blue ;"
        added "ga5 gn5 @ gain ;"
- "keo:12": created "redolbls" to refresh labels for each filter
     : redolbls kct @ 1+ dup gn0 @ ingain w! ex0 @ pexptm !
            filsel kct @ 1+ 4* + @ dup filt# w!
            1- 4* wavnum + @ wvlgth w! parlbl titlbl ;
```

\3 list
BLOCK 883   1563   373

```
- "keo:13:modset": 4444 -> 55555, and mask 15 -> 31.
- "keo:14:or3": lask 4 -> 5, min 4 -> 5.
- "keo:16:kexp": added "redolabls" after "tmelbl".
- "keo:17:run": changed "IF 4 0" to "IF 5 0".
- "keo:21:savemaxmin": added "blue bmin @ mi5 ! bmax @ ma5 !"
- "keo:23:plist": changed "5 1 DO" -> "6 1 DO".
- "keo:23:pshow": changed "5 1 DO" -> "6 1 DO".
- "keo:24:pdisply": changed "5 1 DO" -> "6 1 DO".
- "keo:25:pedit": changed "4 0 LASK" -> "5 0 LASK".
            changed gain comment from (0-7) to (1-4).
```

\4 list
BLOCK 884   1564   374

```
*** 1NOV91 ***
- "init:1": moved "moinit" from BEFORE to AFTER the section
       creating a task to update screen clock.
```

APPENDIX E

```
\file utils
\0 list
BLOCK 900   1604   384

( *** Peter Ning's FORTH utilities       7aug90.)

find -ning   \IF  -ning    \ \      REMEMBER -ning

1 RLOAD cr " loading ning: flpycopy ..."
2 RLOAD cr " loading h-beta support routines ..."
5 RLOAD cr " loading optdsk-loop definition ..."
;s
```

```
\1 list
BLOCK 901   1605   385

: flpycopy ( duplicate floppy disk )
      bell cr
      " *** Warning: using image buffer area 400000h-4FFFFFh"
      cr " Insert source floppy - Hit any key to continue"
      key drop cr " Copying blocks 0-999 to memory... "
      2 unit
      "400000 0 1000 rdchunk              " Done."
      cr " Remove source floppy, insert blank floppy "
         " - Hit any key to continue" key drop
       cr " Writing blocks 0-999 from memory to floppy... "
       "400000 0 1000 wrchunk              " Done." ;


;s                                     8aug90  pn
```

```
\2 list
BLOCK 902   1606   386
```

```
( Additional array operators ... )
: ci-offset p#by @ 1024 - 2/ ;
code   cc ( <src> <#pts> <const> cc )
          PSP )+ D1 MOV,        ( const -> D1 )
          PSP )+ D0 MOV,        ( #pts -> D0 )
          PSP )+ A0 MOV,        ( src -> A0 )
      here
          *W D1 A0 )+ MOV,      ( const -> src )
           1 D0 SBQ,          ( decrement #pts )
          GT B,             ( branch if #pts != 0 )
      NEXT,  C;
( <const> ci-set : Sets current image to value <const> )
: ci-set ( const ) pdat swap ci-offset swap cc ;
-->
```

\3 list
BLOCK 903   1607   387

```
( Vector subtraction: <src1> - <src2> = <dst> )
code   ci--  ( <src1> <src2> <dst> <#pts> ci-- )
          PSP )+ D0 MOV,        ( #pts -> D0 )
          PSP )+ A0 MOV,        ( dst -> A0 )
          PSP )+ A2 MOV,        ( src2 -> A2 )
          PSP )+ A1 MOV,        ( src1 -> A1 )
      here   *W A1 )+ D1 MOV,      ( <src1> -> D1 )
          *W A2 )+ D2 MOV,      ( <src2> -> D2 )
          *W D2 D1 SUB,         ( D1 - D2 -> D1 )
          *W D1 A0 )+ MOV,      ( D1 -> <dst> )
          1 D0 SBQ,           ( decrement #pts )
          GT B,             ( branch if #pts != 0 )
      NEXT,  C;
-->
```

\4 list
BLOCK 904   1610   388

```
( Image subtraction: <image1> - <image2> = <image3>.
         Syntax: <image1> <image2> <image3> ci-diff )
: ci-diff plun @ -rot swap 4 pick 1- plun ! pdat
      -rot 1- plun !  pdat swap 1- plun ! pdat ci-offset
      ci-- plun ! drop ;
( Set up H-BETA Label )
0 variable hbetalbl 20 allot hbetalbl $ H-BETA DIFFERENCE$
```

```
0 variable hbmin        1000 variable hbmax
: hblbl hbetalbl count 200 10 imglbl ;
: hberas 30 1 200 200 lbleras ;
: hbhandle 4 5 6 ci-diff 6 ci sc4 gz hblbl
     hbmin @ bmin ! hbmax @ bmax ! 2bin @ dup zoom ;
;s
```

```
\5 list
BLOCK 905   1611   389

( <startfile#> <endfile#> tape-to-mo : copies image files )
: tape-to-mo 1 + swap do i . clcpt i tr lsho i odw loop ;
: optdsk-loop 1 ci sc1 pz gz init-optdsk 4 repartition
     do i dup odr 2sp " File no. " . cr 2 lzoom
     wvlgth w@ 4278 = if 1 partition snap else
     wvlgth w@ 5577 = if 2 partition snap else
     wvlgth w@ 6300 = if 3 partition snap else
     wvlgth w@ 7320 = if 4 partition snap else
      then then then then drop loop bell ;
: restart tbuf w@ " File number ? " iask optdsk-loop ;
;s                                      23mar86 cds
```

Using the contour command files ...

init.cmd - Initializes all contour variables. This should be the first command file to execute to define and set the default variables.

red.cmd - Sets a contour with a minimum value specified by
green.cmd the variable "min" and the band size with variable "band"
blue.cmd

rgb.cmd - Sets a composite contour of three colors with bands specified by the variables:
rmin,rband,
gmin,gband,
bmin,bband

For example, you want a composite band with the following mapping:
red 0 - 75
green 100 - 150
blue 200 - 255, then type

```
comfile init.cmd
vassign rmin 0
vassign rband 76
vassign gmin 100
vassign gband 51
vassign bmin 200
vassign bband 56
comfile rgb.cmd
```

For only one color, say green we wand a band between 75 150, type

```
comfile init.cmd
vassign min 75
vassign band 76
comfile green.cmd
```

*** Note: Make sure you are in the D:\NW_UTILS\CONTOUR directory when executing the command files. You should change the directory with the "DOS" command after loading the omni system from the "C:\IMAGED\ASIP" directory.

APPENDIX F

CHEAT SHEET FOR THE REMBRANT (updated 10/15/90 MJC)

HARDWARE HOOK-UP

from Omni

Take the RGB outputs from the computer and hook them up to the RGB inputs in the Rembrant.

from asip (monochrome input)

Take the output from the asip and hook it up to the green input in the Rembrant. Disconnect the red and blue inputs to Rembrant.

SETTINGS

from Omni (for BW film)

	R	G	B
contrast	115	115	115
brightness	79	79	79
exposure	0.7	0.7	0.7

film type code - 0

from Omni (for color film)

	R	G	B
contrast	115	115	115
brightness	79	79	79
exposure	1.1	1.1	1.1

film type code - 0

** NOTE : for color film make sure the lens f-stop in the Polaroid Land Film Holder is at 4.5 .

from asip (monochrome input)

	R	G	B
contrast	115	115	115
brightness	79	79	79
exposure	0.1	0.2	0.1

film type code - 4

** NOTE : other film types can be found on p. 47 of the Rembrant manual.

CHANGING THE FILM TYPE

1) press " C " until the yellow prog. light comes on .
2) press " 9 " .
3) enter the film type code number .
4) press the " EXP " button .
5) press " C " until the yellow prog. light goes off .

CHANGING EXPOSURE TIME

1) press " C " until the yellow prog. light comes on .
2) press " 8 " .
3) enter the red exposure time wanted (entering 1 is the equivalent of 0.1 on the LED) .
4) press " , " .
5) enter the green exposure time .
6) press " , " .
7) enter the blue exposure time .
8) hit " EXP " .
9) press " C " until the prog. light goes off .

CHANGING THE CONTRAST

1) press " C " until the prog. light comes on .
2) press " 4 " .
3) press " 1 " , " 2 " , " 3 " depending on whether you want to change R , G , B respectively .
4) press " , " .
5) now increase or decrease the contrast on the LED by pressing " 1 " to increase or " 0 " to decrease the value .

6) hit " EXP " .
7) press " C " until the prog. light goes off.

CHANGING THE BRIGHTNESS

1) press " C " until the prog. light comes on .
2) press " 5 " .
3) press " 1 " , " 2 " , " 3 " depending on whether you want to change R , G , B respectively .
4) press " , " .
5) now increase or decrease the brightness on the LED by pressing " 1 " to increase or " 0 " to decrease the value .
6) hit " EXP " .
7) press " C " until the light goes off .

APPENDIX G

the following is the way that geoplot2.c was compiled .

CL /c /AL geoplot2

link geoplot2 clmqov2 fmap3 pmap2 polyfil2 trans

libs - itexnewl grphcitl davel vcms4l

Correct usage of GEOPLOT2

1) Type geoplot2 /parfile filename.par

   for filename.par enter the parameter file with the necessary information in it .

The program will now plot a lat, long grid for the given parameters. Latitude and longitude markers will also be drawn into the grid overlay.